CLAIMS

1. A safety protection instrumentation system for a nuclear reactor constructed by using a digital logic, wherein the digital logic includes functional units in which output logic patterns corresponding to all input logic patterns are verified in advance and a functional module formed by combining the functional units.

2. The safety protection instrumentation system according to claim 1, wherein each of the functional units individually implements the output logic patterns corresponding to all the input logic patterns on hardware and determines whether the output values coincide with predicted values calculated from design specifications.

3. The safety protection instrumentation system according to claim 1, wherein the functional module includes only the functional unit having same gate structure as that of the functional unit whose performance is verified in advance.

4. The safety protection instrumentation system according to claim 1, wherein the functional module formed by combination of the functional units includes a register thorough which an output from the functional unit is transmitted and a delay element used for adjusting the timing of signal processing in the functional unit.

5. The safety protection instrumentation system according to claim 1,

wherein the functional module formed by combination of the functional units includes a register thorough which an output from the functional unit is transmitted and uses handshaking for transferring a signal between the functional unit that drives the register at different clock frequencies, among the functional units.

6. The safety protection instrumentation system according to claim 1, wherein the safety protection instrumentation system includes software in which effective programs statements executed by hardware and input pattern groups indicating operation paths are described, uses branch coverage or toggle coverage used for evaluating the ratio of the input logic patterns or determining whether the number of the input patterns is sufficient, and determines whether the output logic patterns corresponding to the input logic patterns coincide with predicted patterns calculated from design specifications to verify the connection between the functional units.

7. The safety protection instrumentation system according to claim 1, wherein the safety protection instrumentation system is structured so as to generate input patterns in accordance with design specifications of the functional module and to determine whether the output patterns corresponding to the input patterns in the functional module coincide with predicted values calculated from the design specifications.

8. The safety protection instrumentation system according to claim 1, wherein the safety protection instrumentation system includes an analog-to-digital element that converts an analog signal pattern in accordance with

design specifications of the functional module into a digital value to generate a digital input pattern and a digital-to-analog element that converts an output corresponding to an input in the functional module into an analog value, and determines whether the analog value coincides with a predicted value calculated from the design specifications.

9. The safety protection instrumentation system according to claim 1, wherein the safety protection instrumentation system performs addition or comparison of two variables in the functional unit to replace either one of the two variables with a constant that can be specified with an address having the number of bits smaller than that of the variable.

10. The safety protection instrumentation system according to claim 1, wherein the functional unit has a function of passing an operation flag indicating normal completion of the operation, wherein the functional module has a function of monitoring the operation flag, and wherein the safety protection instrumentation system includes a trip evaluator that receives an output from the functional module and determines whether the operation flag is set and an abnormality diagnosis circuit that outputs an abnormal operation signal if the operation flag is not set.

11. The safety protection instrumentation system according to claim 1, wherein the functional unit has a function of calculating maximum and minimum output values by a simple expression and a function of passing the maximum and minimum output values, and wherein the safety protection instrumentation system includes a trip evaluator that compares

signal values with the maximum and minimum output values to determine whether the signal values are appropriate and an abnormality diagnosis circuit that outputs an abnormal operation signal.

12. The safety protection instrumentation system according to claim 1, wherein the safety protection instrumentation system includes a first safety protection instrumentation system that converts a digital output into an analog value and converts the analog value into an optical signal and a second safety protection instrumentation system that converts the optical signal into an analog value and converts the analog value into a digital value, and wherein the first safety protection instrumentation system is connected to the second safety protection instrumentation system.

13. A method of operating a safety protection instrumentation system for a nuclear reactor constructed by using a digital logic, wherein output logic patterns corresponding to all input logic patterns in functional units in the safety protection instrumentation system are verified in advance.

14. The method of operating a safety protection instrumentation system according to claim 13, wherein data processing in the functional units in the safety protection instrumentation system is serially performed in the order of connection, and the serial transmission of a signal is confirmed by monitoring an output timing and it is determined whether the signal is output as designed to verify the performance of the safety protection instrumentation system.

15. The method of operating a safety protection instrumentation system according to claim 13, comprising the step of verifying whether the functional units in the safety protection instrumentation system have same structure as an internal structure when performance of the functional units is verified.